

Master Thesis
Computer Science
Thesis no: MCS-2010-10
January 2010



Challenges and Strategies in Mobile Phones Interface for elder people

Muhammad Mehrban, Muhammad Asif

School of Computing
Blekinge Institute of Technology
Box 520
SE – 372 25 Ronneby
Sweden

This thesis is submitted to the School of Computing at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Computer Science. The thesis is equivalent to 20 weeks of full time studies.

Contact Information:

Author(s):

Mehrban Muhammad

Address: Folkparksvagen 18:10, 37240 Ronneby, Sweden
E-mail: mehrban_78@yahoo.com

Asif Muhammad

Address: Folksparksvagen 16:8, 37240 Ronneby, Sweden
E-mail: masif24@gmail.com

University advisor:

Bai Guohua
gba@bth.se

School of Computing
Blekinge Institute of Technology
Box 520
SE – 372 25 Ronneby
Sweden

Internet : www.bth.se/tek
Phone : +46 457 38 50 00
Fax : + 46 457 102 45

ABSTRACT

Mostly technological innovation depends on user interface design to enhance the technical complexity of products that match the end user requirements. The acceptance key of any technological product is user experience that how the user understands the end product. In design process a systematic approach is required to optimize user interface design to ensure optimal performance and usability testing.

The main objective of this study is to identify the challenges and issues related to mobile phone software interface design in context of elderly people. The result of this study will support to mobile phone software interface designers and developers. During the investigation authors are trying to discover the usability problems faced by the elderly people using the current mobile phone software interface. The questionnaire technique was selected to collect the requirements from elderly about the mobile phone software interface. The finding of questionnaires was used to develop design guidelines for low fidelity prototype of mobile phone software interface. Moreover, usability testing was conducting to validate the design of low fidelity prototype.

This thesis presents how we design mobile phone software interface for elderly with declining eyesight. Our system enables elderly declining eyesight to use their mobile phone by selecting different display modes.

Keywords: GUI Mobile Phone, Elderly People, Heuristic Inspection, Usability.

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INTRODUCTION

The worldwide Elder people population is increasing very rapidly. According to UN population division report, in the developed countries the population of elder people is increasing at the rate of 1.9 percent annually. Furthermore, prediction shows that in the next four decades elder population will increase by more than 50 percent in developed region [1]. According to UN Population Division/DESA [2], elderly population has been growing from 264 million in 2009 to 416 million in 2050. In 2005, Europe had age of 60 or over 20.3 percent. In 2008 United Nations Secretariat mentioned that in Sweden 60 plus age percentage was 23.3.

In the elderly age period elderly get infected by disease because of low immunity and the most common diseases that are found in elderly are Cancer, Diabetes, Dementia, Parkinson's disease, Cardiovascular (Blood Pressure and Heart Disease) [8, 9].

This Worldwide increase in the elderly patient's population and disease infection rate is an issue to give them care, fulfill their needs and requirements according to their expectations and provide them facilities to communicate with their surroundings.

T. Kleinberger et.al explained that [11], with the increase in the accessibility of mobile information and communication technologies , mobile phones have become the most common communication device to interconnect people. L. Ventä, et al says that [3], in the existing society mobile phones have become the largest selling product with the significant progress in the term of technological innovation and give new shape to our way of living.

Due to the most common way of communication among people, mobile phones could play a significant role to remove the communication gap between elderly patients and care providers. W. Qiuhui, identify that [4], There are number of reasons, that the use of mobile phones could be more important and supportive for elder people. For instance, after retirement many elderly people live in a lonely life. The other cause that is jobs and social pressures, mostly young people does not have much time for caring their elderly parents.

Patrick Roe writes that [5], an informative mobile phones software user interface design is a considerable challenge for the manufactures in interaction design perspective. According to C. Lindholm, T. Keinonen [7], there are different mobile phone vendor developers that develop their own software user interface solution and interaction style.

According to W. Qiuhui [4], elder people have problems when they use mobile phones software interfaces and most of the elderly only use the basic task such as dialing the numbers. In the market there are very few mobile phone manufacturers that focused on the need and requirements of the elder people. Swedish based Telecom Company Doro [16], which is working on mobile phones designed for Baby Boomers and elder people. Doro manufacture mobile phone handset mainly focus on easy to use, large easy to view display screen and keypads, loud and clear sound, hearing aid compatibility, emergency function. The main focal point of these handsets minimizes the communication technology gap to meet the needs of end user seeking design simplicity and functionality in mobile handsets. In

2003 faculty of medicine La Laguna University [17], used a mobile phone terminal message format on the phone for diabetes management. The diabetic patients used SMS to transmit data such as blood glucose levels and body weight to a server. The real time data transfer may lead to more effective use and improved control. MoniCam” – Monitoring Camera [12] and mobile senSAVER (“Sensor Assistance for Vital Events”) prototype [13] is such mobile communication technology that particular build for elderly or disabled patients.

W. Qiuhui said that [4], at present there are many different mobile phone brands in market, but it is very difficult for elderly to understand their complex functionality regarding their software interface. Earlier studies on the mobile phone software user interfaces focused only on the young generation.

In this study we will identify the mobile phone software user interfaces standards that are available in the market for elderly. We will also investigate the mobile phone software user interface designs, which can be use for elderly.

CHAPTER 1: BACKGROUND

1.1 Background

Elder population is gradually increasing in the world. In 2020, the person over the age of 65 is expected to become 20% of the European population [1]. The high growth rate of elder population will have a significant impact on health services. In elder period elderly could be easily infected by diseases such as high blood pressure, diabetes, heart problems or overweight, among other diseases [8, 9].

The aged people especially elder patient it's very difficult to daily seen a medical specialist, visited a clinic, or checked into a hospital every day. The issue of growing of elder population and disease infection rate is to give them proper health care according to needs and requirement. In many cases not easily care provider can visit the patient daily or in short periods of time to keep themselves update about the health of patient [36, 37].

The Information and Communication Technology (ICT) era present the term ehealth (Electronic health). Regarding the ehealth, important information about health is available when and where it's required. Everyday gathering and assessment of health related information is playing a considerable impact on control in prevention of diseases [23]. There are many applications made for ehealth where doctor and patient interact with each other. A number of healthcare applications have failed because their interfaces are complex to use [21]. HCI could minimize these gaps and towards enhancing health knowledge discovery and health support interaction [22].

The wireless technology (Mobiles) becomes common communication technology. Mobile technology, enable secure, real time, distant health care information data transmitted on wireless channels and patients could be able to easily go anywhere they like [23, 27]. A well-designed interface is very important because it satisfy a user's needs, capabilities and limitations in a most effective way. One feature of a good interface is that it unnoticed and another feature is that it allows users to focus more on the tasks and information rather than the way used for presenting the information and the mechanism used to perform a task [27].

The main focus of this study is mobile software user interface for elderly people. According to National Eye institute [20], Diabetic retinopathy is the most common diabetic eye disease which damaged the blood vessels in the retina. In the early stages, gradually changes to your vision. As time passed, diabetic retinopathy can get worse and as a result vision loss. Generally both eyes affects by Diabetic retinopathy. Keep this consideration to develop mobile phone software interface to focus on large easy to view display screen.

The study shows elderly people interaction with mobile phone software interface. This study examines how information and communication technology can be used to support and improve the interaction to the system (mobile phone software interface) by elderly people.

The design of the prototype is one of the main challenges in this study intended users and their needs. The main focus on elderly people with eye sight problems it was extremely important to design straightforward and cognitively interfaces.

1.2 Related Terms

1.2.1 E-Health

The enhancement of information and communication technologies the concept of eHealth would be introduced. The eHealth represents the emerging field in the intersection of medical informatics, public health services and information delivered and improved through the internet and concerned technologies. The utilization of information and communication technology is not only convey a technical development, but also a state-of-mind, a way of thinking, an attitude and a commitment for network, global thinking, to improve health and health care system through locally, regionally, and worldwide [25].

1.2.2 HCI Concept

It is known as human machine interaction. The study of interaction between people (users) and computers is called Human Computer Interaction (HCI). The users communicate or interact with the computer by user interface, which includes hardware and software, for example, general purpose computer peripherals. According to association for computing Machinery defines human computer interaction as "*a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them*" [26].

The objective of HCI is to making computers more usable and provide friendly environment to the users to improve the interactions between users and machine. HCI specifically concerned with methodologies and processes for designing interfaces, methods for implementing interfaces, techniques for evaluating and comparing interfaces, developing new interfaces and interaction design techniques and developing descriptive and predictive models and theories of interaction. The main goal of HCI is to design systems that reduce the hurdle between the human's cognitive model of what they want to achieve and the computers understand of the user's task [26].

1.2.3 Designing Concept

A good interface designing isn't simple [19]. Many things need to be understood in order to design interfaces. These includes people's characteristics (i.e. how one sees, understands and thinks), enhancing acceptance and comprehension of humans by presentation of information visually and to control the movements of eyes and hands to reduce the chances for injury and fatigue. A better design must also take into consideration the shortcomings and abilities of the software as well as hardware involved in the human computer interface [18].

1.2.4 Mobile Phone User Interface

Ketola and R  ykkee says that [27, 28], functional point of view user interface elements divided into seven categories: input (e.g., softkey, alphanumeric keys, and navigation tools), display (e.g., icons and indicators), audio and voices (e.g., ringing tones and microphone), ergonomics (e.g., touch and feeling, and slide), detachable parts (e.g., SIM card and battery), communication method (e.g., Bluetooth), and applications (e.g., making a call, games).

Kiljander identify that [27, 29], there are three user interface types that are more helpful in interaction with mobile phones. These types are logical user interface (LUI), graphical user interface (GUI), and physical user interface (PUI). In this study, LUI (e.g., menu and navigation structure) is defined as interface associated to information contents and structure for task execution. GUI (e.g., icon and font) is defined as interface concerned with graphical or visual items acquainting task-relevant information. PUI (e.g., keypad and microphone) means tangible, physical interface properties supporting users' physical operation required for carrying out tasks.

1.3 Thesis Outline

This section provides the chapter outline of the thesis.

Chapter 2 describes problem definition and goals. The structure of this chapter is as follows: section 2.1 describes research questions, section 2.2 explains goals and measure of study, and section 2.3 presents expected outcomes of this research.

Chapter 3 describes research methodology of the thesis. The outline of this chapter is as follow: Section 3.1 presents the overview of research approach, Section 3.2 discuss the literature review of the thesis, 3.3 contains brief description of informal meetings with thesis supervisor, Master and PhD student, Section 3.3 presents the Questionnaire method for requirements gathering, and Section 3.4 illustrate the prototype of mobile phone GUI interface.

Chapter 4 describes theoretical work of our thesis. The structure of this chapter is as follows: Section 4.1 describes the International guideline of elder people for user interface, Section 4.2 describes user interface design, Section 4.3 presents interaction design and principle, Section 4.4 illustrates mobile interface design, Section 4.5 usability in mobile and Section 4.6 presents evaluation method and techniques.

Chapter 5 describes Questionnaire design and analysis. The sketch of this chapter is as follows: Section 5.1 describes the questionnaire planning, Section 5.2 presents questionnaires for mobile phone evaluation, Section 5.3 illustrate questionnaire designing, Section 5.4 show mobile interface design, Section 5.5. describe the usability in mobile and Section 5.6. presents analysis of questionnaires response.

Chapter 6 describes Interface design of prototype. The structure of this chapter is as follows: Section 6.1 describes the design of prototype, Section 6.2 presents development of GUI of mobile phone, Section 5.3 show the results of prototypes of mobile interface design.

Chapter 7 describes design validation and analysis of results of GUI. The outline of this chapter is as follows: Section 7.1 describes the usability inspection approach, Section 7.2 presents Heuristic evaluation and procedure, Section 7.3 illustrate Heuristic evaluation of mobile GUI, Section 7.4 show evaluation of procedure of validation design, Section 7.5 describe the analysis of validation finding of GUI design.

Chapter 8 In section 1, the authors discuss different challenges, barriers and possible strategies regarding the software interface for elderly people. In section 2 authors give details of the validity assessment of the results.

CHAPTER 2: PROBLEM DEFINATION AND GOAL

Researchers have been taking interest in the healthcare and wellbeing information system for many years. Advancement in embedded computing and ICT has provided the way to investigate, develop and test many health related research works. It is very important to stop the disease before it can be spread particularly for the people with some special needs [30].

In recent past ICT has been used for assisting people with needs, enable elderly to manage their well being and safety. Elderly has been ready to use technological devices to prolong their independent living [31]. Some researchers have been focus on studying visualization of health data and evaluating how elderly health related information of their self management system would be display on a various devices such as PCs, PDAs and mobile phones [32].

Within a self-management system there is a need for interfaces that make the mobile phone more usable and accessible. One approach for addressing this need is to design interface that based on the principles of universal design. Other approach is to create personalized interface this form of interface based on the preferences and abilities of a specific user. The success of any software or hardware is depending on the interaction it provides to its users. The need to provide a user friendly interface has been the challenging task for the manufacturers and designers to keep them active player in the market [33].

The mobile phones user friendliness is requiring the usability. Usability brings many advantages: users are able and willing to use different features of mobile phone. Usability reduces the need of customer support and increase the satisfaction level of users. Reduction in the size of mobile phone and increasing the numbers of functions makes designing more challenging task. Other design challenge is the short life span of mobile phone model resulting less time for development [6, 34].

There is much competition in mobile phone manufacturer that how to provide the products that are usable, attractive and reasonable for different types and classes of users. No doubt the market success is depend on the products that are launched in general population's interest [5], but the products that are designed considering the normal users preferences may not be ideal for users having some special needs.

To investigate a mobile phones software user interface which is suitable for elderly people is the main focus of our study. The above challenge or problem contribute the important role in our study. Through this research study we will try to investigate evolutionary ideas in mobile phones interface design which is suitable for elderly people, so that they can also enjoy the technology like other main stream users.

2.1 Research Questions

In this study we try to find the answer of following research questions.

RQ:-1. What are the challenges in software user interface design of mobile phone for elderly people?

RQ:-2. What could be the strategies for resolving the issues and challenges in software user interface design of mobile phone for elderly people?

In our first research question we will try to find the challenges faced by mobile phone interface for elderly people and in second research question we will present the strategies to eliminating the challenges mobile phone interface for elderly people faced.

2.2 Goal and measure of the study

The Goal of our research is to help elderly people by supporting mobile phone interface designers to understand the needs and requirements of elderly people. The primary goal of our study will be

- To identify the standards of mobile phone software interfaces for elderly and provide ideas to minimize the gap between elderly people and mobile phone software interfaces.
- To construct a test version of mobile phone software interface according to the enhancement elderly people want in current software user interface of mobile phone.

2.3 Expected Outcomes

Expected outcomes will be a report, which will cover the following.

RQ-1EO.1:- Identification of the popular standards of mobile phone software interfaces for elderly and provide ideas to minimize the gap between elderly people and mobile phone software interfaces.

RQ-1EO-2:- Present a report helpful for mobile phone software interface designers regarding elderly people needs.

RQ-2EO-3:- Come up with the survey results; identify the elderly people needs and enhancement which elderly people want in software user interfaces of mobile phone.

RQ-2EO-4:- Construction of a test version of mobile phone software user interface according to the enhancement elderly people wants in software user interface of mobile phone.

Our research will support elder people by helping them to identify their needs regarding their current and future software user interfaces of mobile phones. Furthermore our research will also support mobile phone interfaces designers by helping them to understand the needs and requirements of elderly people.

CHAPTER 3 METHODOLOGY

In this chapter we discussed the research methodology of the thesis. The research did into three phases of time line: requirements gathering, design & development and validation. These phases discussed in this chapter.

3.1 Overview

Authors used mix method research approach [38] in order to explore ongoing research on software user interface for mobile phones. To complete this study authors were perform the literature review, which enable them to know the standards of mobile phone software interfaces for elderly and the challenges involve in software user interface design of mobile phone for elder people. Furthermore in second phase of research, authors conducted surveys to analyze the elderly people needs regarding mobile phone interfaces. It was also identify the satisfaction level of elderly with current software user interfaces of mobile phone. Authors constructed a test version of mobile phone GUI according to the standard guidelines of software user interface. At the end authors conducted a test to validate the design of mobile GUI.

This research enabled us to present an insight about the responsible factors concerning the issues and challenges of the user interface design for elder people. Following diagram illustrate the research process of this study.

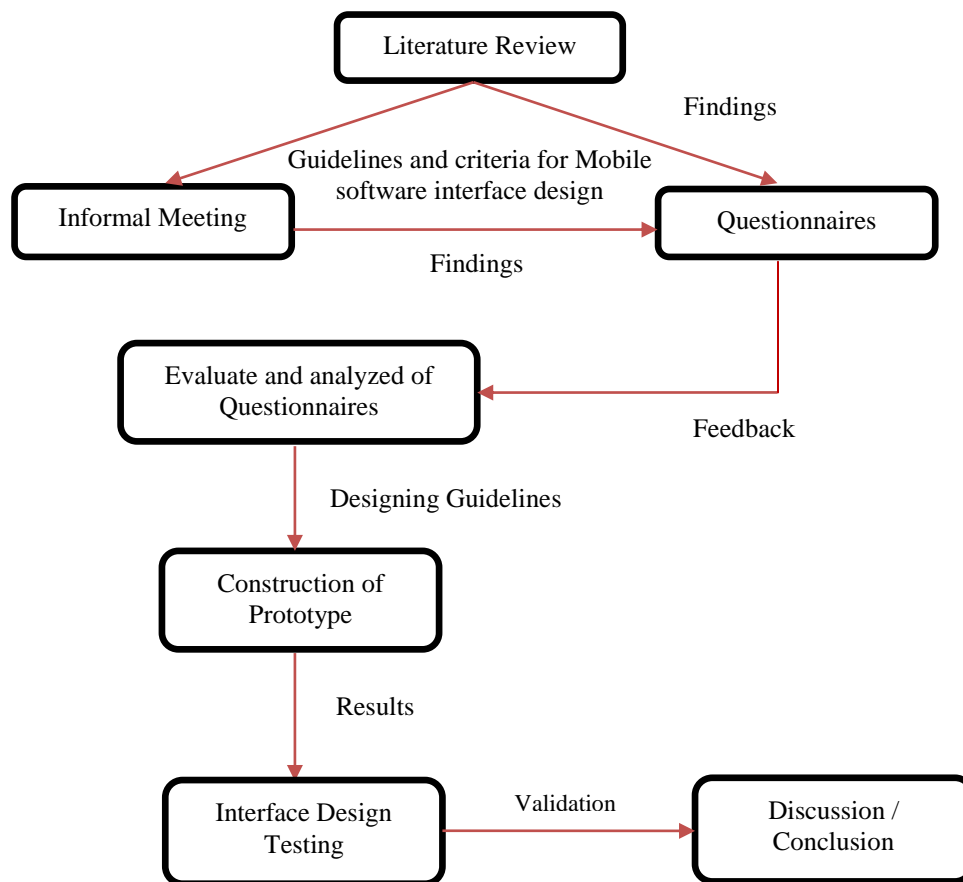


Figure 3.1 Overview of Research Methodology

3.2 Literature Review

The basic idea of literature review was to provide a proper context to a research and educate the researchers from the previous work done by other researchers [39]. Literature review was the initial phase to get the current state of research in mobile phone software interface design for elderly. Authors used the different keywords relevant with the research topic to search the material available by well known scholars.

In initial phase detail literature review was done to understand the standards of mobile phone software interface design for elderly and identify their most important software interface design factors in the context of elder people. Blekinge Institute of Technology (BTH) Electronic Library was used as net surfing to search the “Software Mobile Phone Interfaces for elderly” and related data. Authors selected research papers, journals and books related to Mobile Phone Interfaces for elder people and HCI that were Google Scholar, ACM, IEEE, Compendex, ebrary, elin@Blekinge, electronic thesis reports and PhD thesis reports.

3.3 Informal Meeting

Author did informal discussion with our thesis supervisor, master and PhD student to discuss the mobile phone interface for elderly. Author received positive and helpful responses from supervisor, fellow students to design the questionnaires and in the development of the test version of the GUI for mobile phones.

3.4 Questionnaires

The questionnaires were designed on the basis of informal discussion and literature review. Questionnaires are distributed to the elderly people to get quantitative data to design the GUI of the mobile phones according to elderly people needs. Questionnaires are formulated open ended and close ended that will provide the opportunity to elderly people to express their ideas and problems about the current mobile phone interface and analysis of questionnaires to develop GUI for future mobile phones.

3.5 Prototype

Prototype is a technique which is used in building a system or a part of the system in short interval of a time. Prototype is defined as the process of developing a system or product that demonstrates the feasibility of a solution to a problem. Prototype generally operated by their developers or those who understand its underlying technology [40]

CHAPTER 4 THEORETICAL WORK

This chapter describes theoretical work of our thesis. This work describes Guidelines of elder people, presents the User Interface Design and Interaction Design, Principles to explain Mobile Interface Design, enlighten the Usability in Mobile through evaluation method and technique.

4.1. Guideline of Elder People for User Interface Standard

This part describes some common guideline of elder people in the context of user interface. These standards are used to form specialized system for world wide. The main aims of these standards are to assure and develop information accessibility from information processing tools such as personal computers, web content and electronic guides. This section briefly discusses the International Standard, and U.S laws.

4.1.1. ISO/IEC GUIDE 71

The ISO (International Organization for Standardization / IEC (International Electrotechnical Commission) designs a uniform products and services standards for elder people. It is essential for society because accessibility issue has become more serious with the increasing number of elder population in the worldwide. The standard design of product and services has significantly influences on the customer interests. Though, this necessitates to be considered within the limitation that standards should normally not be design restrictive [41].

The ISO/IEC Guides are providing direction to international standards on products, services and environments for elder and disables people. The guidelines are identifying the matrix for sensory abilities (Vision, Hearing, touch, taste/smell, And Balance), physical abilities (Dexterity, Movement, Manipulation, Strength, and Voice), cognitive abilities and allergies [41].

Sensory Ability (Vision)

In vision impairment related area a number of problems are arising in the seeing function. The seeing function like sensing the presence of light and sensing the form, shape, size and color of visual stimuli. In increasing age the frequency and harshness of visual impairment is high [41]. The visual functions which changes the eye affect, containing: [41]

- Loss of visual acuity (nearby and at a distance)
- Reduced field of vision
- Perception of color
- Depth perception
- Speed of adaptation to changing light levels and sensitivity to light.

With the help of these matrixes, identifying and marking those aspects relevant to their International Standard. The Matrixes showed in Table 4.1 and 4.2 presents a tool relating aspects and characteristics of a product, services or environment, to human abilities [41].

Table 4.1 Matrix of Sensory Ability

Information	Vision
<ul style="list-style-type: none"> — Labeling — Instructions — Marking — Warnings 	<ul style="list-style-type: none"> — Size and style of font — Color and contrast — Glare — Location — Surface finish — Layout structure — Alternative format — Lighting

Table 4.2 Matrix of Sensory Ability

User interface	Vision
<ul style="list-style-type: none"> — Controls — Feedback 	<ul style="list-style-type: none"> — Intuitive — Layout — Angle of view — Location — Avoidance of interference — Minimizing simultaneous stimuli — Providing information on surroundings — Size — Color and contrast — Spacing — Identification — Feedback on status — Alternative format — Luminance

4.1.2. US Section 508 Rehabilitation Act

In 1998, Congress modifies the Section 508 Rehabilitation Act to make their electronic and information technology accessible to people with disabilities. The users are able to individually access the technological information quickly and easily. This modification could eliminate difficulty in information technology and make opportunity and support the development of technologies that will help accomplish these goals for disable people [42].

Most of the software specification concern to usability for user with vision impairments. Such as, one provision wants alternative keyboard navigation, which is necessary for user with vision impairments who cannot rely on pointing devices, like as a mouse. Other provisions concentrate on animated displays, contrast and color adjusting, flash rate, and electronic forms, among others. The following some standard are summarized from section 508 of Rehabilitation Act, §1194.21.

Table 4.3 Section 508 of Rehabilitation Act, §1194.21

Technical Standards	
Screen	Well define on screen indication Track focus Focus changes
User Interface Element (Image)	Conveyed fully Information Text Form
Permit User	Contrast level Color Adjustment Variety of color selection
Displayed Animation	Information display in non-animated presentation mode
Color Coding	Indicating an action Prompting a response Distinguishing a visual element
Flashing or Blinking Text	Software Shall not used Text
Objects or other elements (Flashing or Blinking Text)	Greater than 2Hz and Lower than 55Hz

4.2. User Interface Design

The study of user interface design is subset in the Human Computer Interaction field. In HCI main focus on how to design, plan and study the people and computer together as a result person's needs are fulfilled in the proper and successful way [43].

In the field of computer, the user interface is essential part of hardware and software through which people interact in different way such as see, hear, touch, and talk to. There are two main components of user interface the input interface such as keyboard, mouse, trackball, one's finger (for touch-sensitive screens or pads), and one's voice (for spoken instructions) and output interface such as the display screen, voice and sound [43].

4.2.1. Importance of User Interface Design

It's necessary to well design appropriate input and output interface design mechanisms that satisfy the user's needs, in the sense of limitations and capabilities in the most effective and efficient way. The main thing in best interface design is the focus on the information and task of different users instead of the user interface design mechanisms used to present the information and perform the task [43].

A poor user interface design could affect in different ways like screen layout, appearance and system navigation. Furthermore, complex user interface design can create difficulties for user when they are performing their jobs and will also increase the chances of mistakes [43].

4.2.2. Interface Design Affect

According to Perlman, G. [44] *“It is difficult to develop good interfaces .We knows this because there is no shortage of bad user interfaces, even in products where developers tried to incorporate ‘user friendliness.’”*.

The poorly designed features that affect the interfaces are main targets of criticism but their origins are unobserved. The use of new interface design methods and tools are important but we must give the importance to existing design practices that provides an opportunity to the new methods and tools to be use in practice [45].

4.3. Interaction Design and Principle

The application has good interface creates good impact, understanding and consciousness among the users for guiding them in different dimensional modes for achieving their goals.

4.3.1 What is Design and Goals?

The effective design presents the organization of objects which communicate information to a target user [46]. According to W.O. Galitz [43], the primary focus of designing goals decrease the intellectual visual memory, and motor work and also reduce the technological instruction that put burden on the user.

The design mainly concerns the end users to interact with the system in the organization. During design you should identify all knowledge about that user [46]. The following profile factors of end user plays an important role in user interface development:

1. Age—and the indirect cultural influences and education levels
2. Life experiences—and family background
3. Language—words, tone and usage
4. Visual literacy—understanding level of symbols and metaphors.

4.3.2 Design Principle

According to D. Benyon et al. [47], generally most common design principle such as Visibility, Consistency, Familiarity, Affordance, Navigation, Control, Feedback, Recovery, Constraints, and Flexibility, are normally concerned to the development process.

The main focus of visibility is to ensure the things that are clearly seen to users in the provided interface for better understanding. During designing use a reliable features to guarantee the consistency. Familiarity is concern the language, to make system more memorable with user. Affordable means display in a way that makes clear understanding such as links and buttons presents their meaningful message to user. Through Navigation, the users allow to move everywhere in the system. Control gives access permission to the users.

User received quick feedback from the system through Feedback method. Through Recovery, the user recover the system from error or mistake when occur while the Constraints prevent them from improper actions. Flexibility permits different approaches to do things for learning reasons. The style of interface should be attractive and smart that makes a friendly association between users and system [47].

4.4. Mobile Phone Interface Design

User Interface defined as aggregate means through which a user communicates with a system. The user interface is an important component of any program because it determines how easily you can interact with the system. A good program with a poor user interface design has little value (Patrick Joseph, 2004) [73].

Mobile phone interface consist of three components: user interface, service interface and external interface [28] as shown in table 4.4. The user interface includes both hardware and software interface. The hardware interface includes input methods, ergonomics and communication methods. Software interface focus on the designing of the menus such as color, font size, navigation logic and application. The service interface components that make possible use of the phone services provided by the service provider. For example text message services, calling plan service etc. Lastly the external interface involves features that help in using the device such as accessories and supporting software [48].

Table 4.4 Mobile phone interface components

Interface	Category	Examples
User Interface	Hardware	Size, weight, shape ,touch and feeling ,display size and resolution
	Software	Icon design, Font size and color, Interaction logic, control key combination , menu labels, layout menu structures, audio and graphic design, utility application , game application etc.
Service Interface	Services	Phone bill, service coverage, calling plan, email, navigation service, text messaging service.
External Interface	Support	Documentation, manuals and help
	Accessories	External keyboard, Hand free sets, charger.

4.4.1 Impact of Poor Design

Mobile phone user interfaces are very simple. However, the two major technological trends such as miniaturization and addition of more functions are challenge to the designer and usability engineers. Sometimes due to the small screen, functions and options cannot be displayed together on one screen. Furthermore, the hierarchical menu system is required to access these function and option. In the hierarchical menu system a different selection and actions are required to perform a function. In some cases when users navigate into the deeper menu structure, they cannot see the previously selected menu items. In addition, the user must remember the order of actions while using the mobile phones. According to Lee et al. currently the mobile phone manufactures are more focus on utilize icons instead of text labels [50].

4.5. Usability in Mobile

According to ISO 9241-11 [51], “*The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*”. In high fidelity testing main focus of user response is on the surface elements rather than key structure. During product development process high and low fidelity testing play different roles. Furthermore, in process development usability testing done in design and implementation phase to find application related problems and issues with design.

In usability field testing, usability tests can be performed in different ways such as in a laboratory, emulator and simulators or an actual device and outside of the laboratory. Through Simulators and Emulator permit coders to view their applications on the PC, it cut down the number of steps essential to do unit testing. While, in laboratory testing experience persons are needed to perform usability techniques to the actual application. In addition, testing is conduct outside the laboratory to involved the participants and ask them to perform tasks. [49]

4.6. Evaluation method and techniques

4.6.1 Questionnaires

A questionnaire is a method to collect data from the target user in specific knowledge domain. According to Preece et al. [52], “*Questionnaire is a well known technique to collect demographic data and users’ opinions*”. A design of questionnaire is important thing because it addresses the research issues and hypothesis on which data are to be collected. In questionnaire the questions can be closed or open ended.

In questionnaires, initial part is mostly concern with demographical and experiential information. This user information could be evaluated in finding out the range from the sample group and their experience of interaction with the system. Generally in questionnaire, a long question divide into parts that user can easily and clearly understand the question [52].

4.6.2 Design Prototype

The main function of prototyping is to put the design in a form that can be manipulated, considered, and tested. Prototypes can be in many forms show in Table 4.5. The prototype will often depend the available time, the skillful designers and complexity of the interface. The medium and high fidelity prototypes presents more accurate test for users because its more closely to final product but limit number of iterations is required that can be completed. Many quick iteration is possible will allow in low fidelity prototypes. Usually, low fidelity prototypes are used in early iteration to general look, feel and overall navigation evaluation [53].

Table 4.5 Forms of Prototype

Prototype Form	Description
Low Fidelity	Simple Paper Based or Computer Based Drawings
Medium Fidelity	Pseudo-Application, Show some Functionality, like Connect data or arranged scripts
High Fidelity	Look like Real Application, Perform almost all of the functionality of the product

4.6.3. Heuristic Approach

Heuristic evaluation is an informal usability technique commonly used for finding major usability problems in a user interface. Heuristics evaluation is type of usability inspection method, which examines and judge the user interface for usability issues. In this technique three or more experts are required to individually apply a set of usability heuristics to a product in order to identify problems and assess the severity of each problem. User interface element such as menus, dialog boxes, and navigation structure etc., should be match to usability and design principles. Preece J., at al. [52], represents the observation resulting an assessor's estimate about what requires to be enhanced in a user interface. The Table 4.6 addressed the heuristics questions when undertaking a system assessment for usability problems detect.

Table 4.6 Question Addressing in Prototype Evaluation

Nielsen's Heuristics	Questions Addressed in the Evaluation
Visibility of system status	Are users kept informed about what is going on? Is suitable feedback provided within reasonable time about a user's action?
Match between system and the real world	Is the language used at the user interface simple?
User control and freedom	Are there ways of permitting users to easily escape from places they unexpectedly find themselves in?
Consistency and standards	Are the ways of performing related actions consistent?
Help users recognize, diagnose and recover from errors	Are error messages helpful? Do they use plain language to explain the nature of the problem and propose a way of solving it?
Error prevention	Is it easy to create errors? If so where and why?
Recognition rather than recall	Are objects, actions and options always visible?
Flexibility and efficiency of use	Have accelerators (i.e. shortcuts) been presented that permit more experienced users to carry out tasks more quickly?
Aesthetic and minimalist design	Is any pointless and inappropriate information provided?
Help and documentation	Is help information provided that can be simply searched and simply followed?

CHAPTER 5 QUESTIONNAIRE DESIGN AND ANALYSIS

Questionnaire is an inexpensive way to collect data. A well-designed questionnaire can be used to collect the information on specific area of the system.

5.1 Questionnaire Planning

After the literature review and informal meeting with our supervisor we planned a questionnaire with the county of Blekinge elderly citizen. The questionnaire purpose was to collect the qualitative and quantitative data to identify the problems associated with the mobile phone software interface for elderly people. In questionnaire we discussed mobile phone interface challenges and issues related to elderly people. When questionnaire completed then statistical analysis was done to analyze the final results.

5.2. Questionnaire for Mobile Phone Evaluation

The questionnaire was designed to collect the users understanding and experience with mobile phone. It was designed to measure the usability of the mobile phone and elderly people requirements regarding it.

Authors asked the questions in the questionnaire with the selected criteria for mobile phone software interface evaluation, ease of use, ease of learning, usefulness & problem solving, and memory load with the software interface of mobile phone.

The questionnaire was designed with the all possible question that support authors to find out the elderly people requirement as well as usability issues. The selection of questions and criteria is adopted from [54].

Authors select [54]; Mobile Phone Usability Questionnaire (MPUQ) that specifically measures mobile phone usability. Author's selects sixteen questions from MPUQ that measure four usability factors: ease of use, ease of learning, usefulness & problem solving, and memory load.

5.3. Questionnaire Designing

In designing questionnaire, the primary focus was on easy, short and simple questions that understandable to the elderly people. We follow a closed ended and Likert scale Questionnaire designed pattern to carry out research survey. The rating was collected using a 5-point Likert scale with following order: 1-Strongly agree and 5-Strongly disagree [55]. The design of Likert scale questionnaire was first introduced by Renss Likert. We also used this method to design the questionnaire. The questionnaire is given in Appendix. The questionnaire form has four sections

Section A: - The first section was based on general question about mobile phone usage. To know the reason of mobile phone usage i.e. personal communication, information, safety and security, and entertainment.

Section B: - The second section was based on “Mobile Phone Software Interface” to know about the elderly people understanding and experience. To identify the ease of use, ease of learning, usefulness & problem solving, and minimal memory load with the software interface of the mobile phone.

Section C: - Third section presents use of technology. To know how frequently elderly people use the computer, internet and email.

Section D: - Fourth and last section describe about the demographic information and use of any health application.

5.4. Piloting Questionnaire

Before distributing to elderly people, questionnaire was piloted to make sure that there are no confusing questions and questions are clear and understandable. Piloting helped us in removing error and making changes to some questions.

After completing piloting questionnaire test, participants suggested some changes in questionnaire designing. We make changes accordingly. We changed the order of some questions and also corrected grammatical mistakes. After the final review we distributed the questionnaire as discussed in the next section.

5.5. Distribution of Questionnaire

After designing the questionnaire it was distributed to the county of Blekinge elderly citizens. Elderly who are using mobile phone were selected for questionnaire conduction. Hard copies of the questionnaire were distributed among elderly people at different times.

5.6. Analysis of Questionnaire’s Response

5.6.1 Mobile Phone Interface Understanding and Experience

Authors received only five responses out of seven from Blekinge senior citizen. Elderly have different thoughts and thinking regarding the mobile phone understanding & experience, but their comments is very significant for evaluation.

Table 5.1 Questionnaires Response

Criteria	Number of Question	No. of Responses	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Display	4, 5, 8, 9, 12	5	8,69%	34,78%	34,78%	8,69%	13,04%
Ease of use	1, 2, 3, 6, 7, 10, 11	5	2,85%	37,14%	54,28%	2,85%	2,85%
Ease of Learning	13, 14	5	Nil	44,44%	33,33%	22,22%	Nil
Usefulness and problem solving	15	5	Nil	50%	10%	40%	Nil
Minimum Memory Load	16	5	Nil	60%	40%	Nil	Nil

The above table 5.1 shows the percentage of the elderly response against the criteria (Display, ease of use, ease of learning, usefulness & problem solving and memory load) that had chosen for usability evaluation of mobile phone software interface.

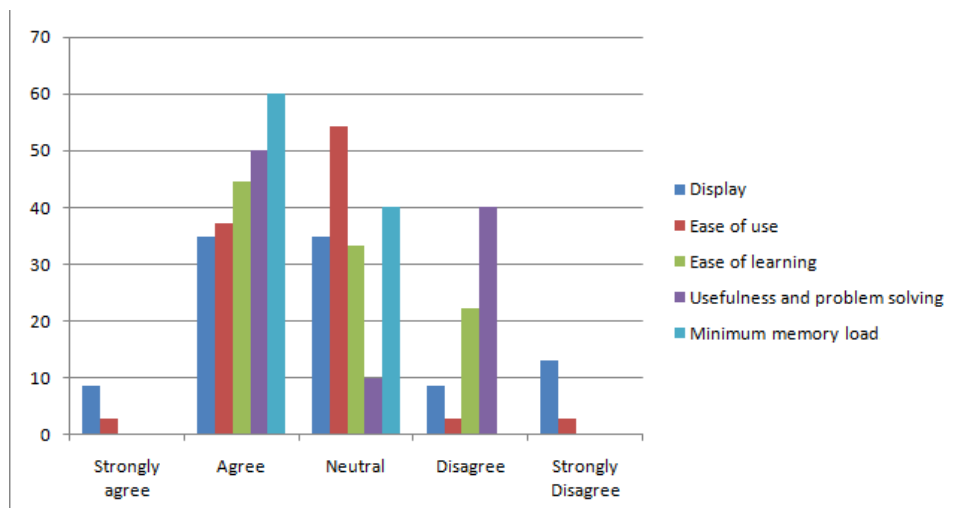


Figure 5.1 Percentage of Questionnaires Response

The fig 5.1 describes the responses of the elderly people relevant to questionnaire's criterion. In questionnaire analysis authors analyzed that to some extent elderly are satisfied with the mobile phone software interface and considerable ratio of elderly has a neutral response in favor of satisfaction level with mobile phone software interface display attribute.

Furthermore authors analyzed that more than half of the elderly have a neutral response against simple and easy to use mobile phone software interface attribute. It indicates majority of the elderly thinks that their current mobile phone software interfaces are not up to the satisfaction level of simplicity and ease of use. On the other hand elderly ration with a little closer to majority level are agreed with the simplicity and ease of use attribute of mobile software interfaces.

Moreover when authors are analyzing elderly behaviors against ease of learning attribute, they identified that majority of the elderly are not feeling any difficulties in learning their mobile phone software interface. In addition to this considerable ratio of elderly have a neutral response against the same attribute. Authors found that the elderly who are not satisfied with the learnability attribute of mobile phone software interfaces have a half ratio as compared to the elderly who are satisfied.

When moving towards the usefulness and problem solving attribute of mobile phone software interfaces authors identified that half of the elderly thinks that their mobile phone software interfaces are useful and it also enables them to solve problems by themselves instead of taking help from others. In addition during analyzing questionnaires authors came to know that a close ratio to the half of the elderly are not satisfied with the usefulness and problem solving attribute of mobile phone software interfaces.

During analyzing minimum memory load attribute authors identified that more than half of the elderly are completely satisfied. Authors analyzed that elderly are working satisfactory according to their needs and they do not have to put efforts on memorizing things when they are dealing with current mobile phone software interfaces. In addition to this a little closes to the half ratio of elderly have a neutral response against minimum memory load attribute of mobile phone software interfaces.

5.6.2 Use of Technology

Table 5.2 Use of Technology

Technology	More than once per day	Once a day	Once per week	More than once Per week	Never
Computer	40%	20%	Nil	20%	20%
Internet	40%	20%	Nil	20%	20%
Email	40%	20%	Nil	Nil	40%

The above table 5.2 shows the percentage of the elderly response against the use of technology (Computer, internet and email).

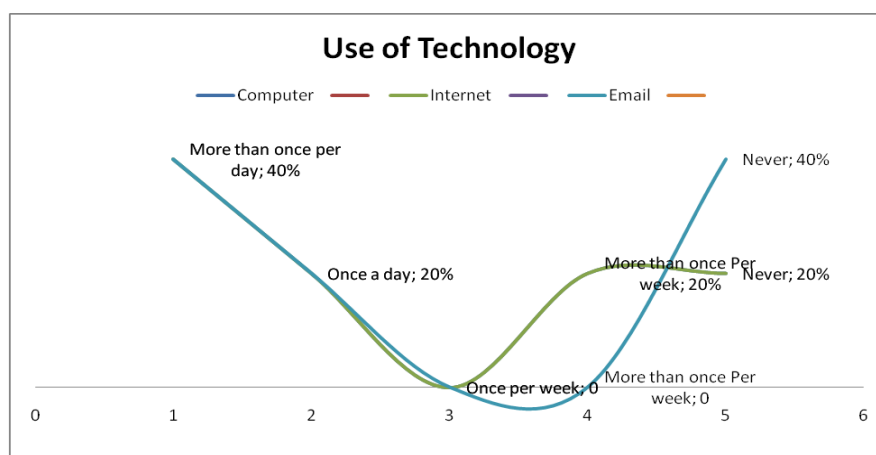


Figure 5.2 Graphically representation of Use of Technology

The fig. 5.2 describes the responses of the elderly people relevant to questionnaire's criteria about the use of technology. When authors are analyzing the use of technology questionnaire, they identified that majority of the elderly are in favor of using computer and internet. On the other hand considerable ratios of the elderly do not use email.

5.6.3 Reason for Mobile Phone

Table 5.3 Percentage Reason of mobile phone usage

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Personal Communication with family and friends	60%	40%	Nil	Nil	Nil
To save information e.g. phone numbers & personal notes	20%	20%	Nil	Nil	60%
Safety and security	100%	Nil	Nil	Nil	Nil
Entertainment e.g. game and music	Nil	Nil	Nil	Nil	100%

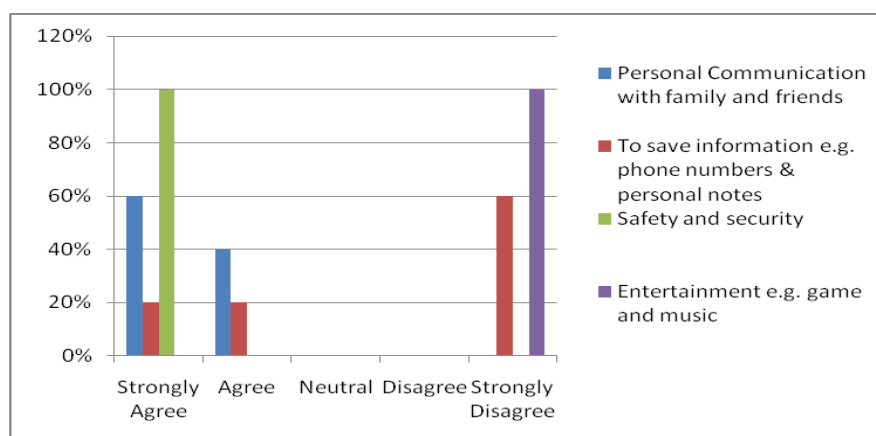


Figure 5.3 Graphically Representation of Mobile phone usages

The above fig. 5.3 shows the percentage of the elderly response against the reason of mobile phone. Average 50 percent elderly are using mobile phone for personal communication with friends and family. On the other hand no one disagree with this statement. Majority of the elder do not agree to use mobile phone to save information like phone numbers and personal notes. 100% elderly agree with this statement that they use mobile phone for safety and security.

5.7 Questionnaires Consequences

From the above analysis it was found that elderly people had several issues related with design of the mobile phone interface. The main issues that some or all of the elderly with the design of the mobile phone interface are the following.

- Difficult to read the characters on the screen.
- Organization of information on the screen is unclear.
- Color coding and data display are incompatible with familiar conventions.
- Difficult to navigate between hierarchical menus and screen.
- It is difficult to remember how to perform tasks with the mobile phone.
- Feedback on the completion of tasks is unclear.
- The design of the icons, symbols and labels are irrelevant.
- They do not use internet and email because of interaction problem.

The discovery of these issues helped us to establish the guidelines to overcome the difficulties elderly had found previously when using mobile phone. We found interface design guideline from previous studies.

5.7.1 Color

Elderly having more difficulty in sorting and matching colors [56]. Czaja et. al explained that [57], the contrast sensitivity and color discrimination ability is decline with aging. According to Lighthouse International [58], designers should be having knowledge of the three perceptual attributes of color to make an effective choice: hue, lightness and saturation.

- Hue classifies: blue, yellow and red colors.
- Lightness represents required level of the light that appears to be reflected from a surface.
- The color's intensity is measured with saturation.

During designing avoid some colors that are high bright, fluorescent, or vibrant that appears to blur as a result tire the eyes [59]. Such as yellow text label is very hard to read. To maximize the contrast between foreground and background colors avoid similar colors adjacent to one another [58]. To ensure that all relevant information related with color is also accessible without color.

5.7.2 Font

The selection of fonts is based on readability factor to ease reading and ignore the unnecessary like very narrow or decorative fonts. During designing keeping in mind exactly what the users see. Avoid using too many different types of fonts. Elder people easily

recognize larger font and twelve to fourteen point fonts are proposed for body text. Sixteen or above point is recommended to partial eye sight [59, 60].

According to [60], there are several typefaces are existing that is light, narrow, bold, or extra bold. The readability is reduced while boldfaced text appears larger and use bold only to highlight a keyword or a title. According to [59], readability is affected to using all capital letters because it required high level of eyestrain and eye fatigue due to slight differentiation between the letters and eyes does not get a visual breather.

5.7.3 Navigation Mechanisms

Elderly people are more likely to get lost while navigating due to memory decline. Deep hierarchy always avoid and providing understandable and consistent navigation mechanisms. The site map, navigating bars and orientation information should be provided so that the user find his or her location easily [62]. To ensure links to make them identifiable and recognizable that makes navigation mechanism consistent and easier for users [60].

5.7.4 Content

According to [62], presents a text should be equivalent for non-text elements (graphical representations) such as images, animations, ASCII art, graphical buttons, sounds, stand alone audio files and so on. The power of text correspondent lies in their capacity to be rendered in ways that are available to elder using a diversity of technologies. It's very beneficial especially who has difficult to reading or non readers, to present non text elements equivalents to text sometime.

Elder people have difficult to recognize the information. They required more visual search skills because mostly elder people have not much experience of interface interaction. This needed to minimize the unnecessary screen information [57, 61]. Therefore it's essential to displayed basic information on the screen and should be highlighted the essential information with utilize simple and relevant graphics.

5.7.5 Layout and Style

According to [59], to enhance readability, making pages easier to navigate and clear seeing, to use large areas of white space and small blocks of text. The usability issues is improves with different monitor types, window size and display resolution. The information organize should be clear on the screen because due to elderly is more attention required on visual search skill. The relevant information put together such as grouping that elder easily to read the information.

Low vision people have difficult to read and get the information from ambiguous backgrounds. It becomes harder to read or understand of things or objects due to background patterns, floating text over color, images that difficult to understand [56].

According to [62], elderly people could not read the moving, flicking, scrolling, blinking of text, and objects. According to [57], display larger graphics that easily to click because mostly elderly with impairment in motor ability.

CHAPTER 6 INTERFACE DESIGN

In previous chapter we analyzed questionnaires of mobile phone software interface from the user point of view. It can identify the GUI problem they faced in the current mobile phones. After the questionnaires analysis we find out the ideas that how the GUI might look like and how to navigate. In this chapter we discuss the development process of the mobile GUI.

6.1 Design Prototype

The designers could easy achieve the user interface design idea through prototyping. It is good and cost effective way of working through promoting, rejecting and refining them. We selected the low fidelity prototype because it is more easily making. It is created at earlier stage of design process before the exact details are known.

In low fidelity prototyping is commonly sketching of an interface. The designer could deployed the idea on paper or electronic drawing, which allow to see how their interface might look like such as button position, number of button, text fields size, display and feedback etc [63].

6.2 Development of GUI

The development process is dividing into two phases. In first phase we discussed the design requirement of mobile phone graphical interface while in second phase presenting the results.

6.2.1 First Phase

Functionality Identify: - The identification of functionality was provided another group of researcher who classify the mobile phone functionality for elder people. They made and provided some of the architecture of functionality for designing i.e.

- Phonebook
- Messages
- Alarm
- Setting

Design process: - In the design process we investigate the mobile phone graphical interface for elderly people. As above mention that could gradually decrease in eye sight that we design a mobile phone user interface according to eye impairment.

Mobile phone Cell: - The display of mobile phone is main item to meet all the requirements for elderly people. Therefore our prime focused on display size. From the literature review [64], Authors find out the following properties of a mobile phone was important for elder perspective:

- Large display
- Large keypad
- Clear marked

Colors set: - According to [64], selection of red and green colors for interfaces is not feasible for eye impairment people. Therefore the design of different color sets was rejected because elder would not require color perception.

Icons Set: - Icon is a little pictogram. In modern technology the icons are widely used to support users. It can represent in bitmapped graphics on the display terminal. With help of icons the user could easily understand the interface especially vision impaired users. During designing mostly icons are selected from the previous studies.

Fonts Set: - There are number of font families but we select the Serif type (Time New Roman) because it include extra feet at the ends of the strokes and shape of each letter vary in line weight [60]. In designing, our prime focus was on size of fonts and type that should be easily understands. The twelve to sixteen size of font could be recommended to elder people for easily recognized.

6.2.2 Second Phase

In the second phase we designed the mobile phone graphic interface pages into three categories i.e. Normal mode, Medium, and Large mode.

GUI process Design: - A. Botond said that [64], the implementation of GUI development process is consisting on different control groups used for to construct the GUI. In Figure 6.1 present one side interface.

- **Frame:** - It allows the user to navigate between different pages in the interface.
- **Page:** - The page is able to contain information such as lists and menus.
- **Menu bar:** - It creates soft-key menus.
- **List:** - It presents the structured form of various objects. It allows navigating between different objects and select objects.
- **Form:** - A form able to group controller that you can navigate between multiple fields.
- **Text Field:** - it is used for text input.

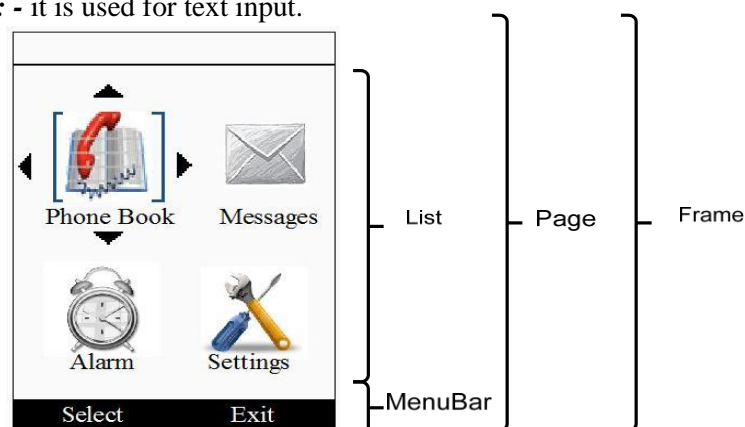


Figure 6.1: Development of Mobile GUI page

Modes: - The GUI of mobile phone could be displayed into three different modes i-e Normal, Medium and Large Mode. Authors introduced the following modes of functionality in which elderly people are able to magnifying setting of mobile phone software according to their own requirement. Each mode has their own interface of icons, fonts and color combination.

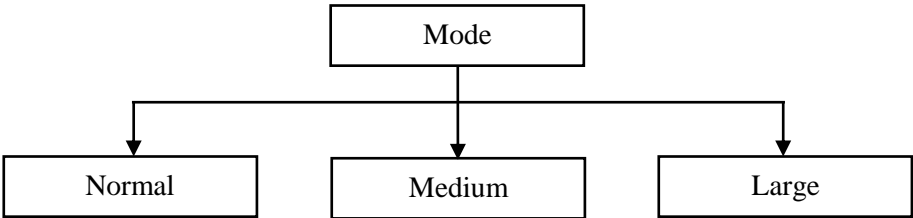


Figure 6.2: Mode

6.3 Outcomes

Author follows the L. Constantine and L. Lockwood usage-centered design in development process of GUI of mobile phone to improve the quality of user interface design [65]. According to these principles

Visibility: - The interface design of the proposed system provides visibility and clarity in all aspects. As we can see from figure an unobstructed view of interface design. The visibility functionality is achieved in all modes through the use of icons, labels and buttons as shown below.



Figure 6.3.1:
Main Menu, Normal
mode, phonebook
selected

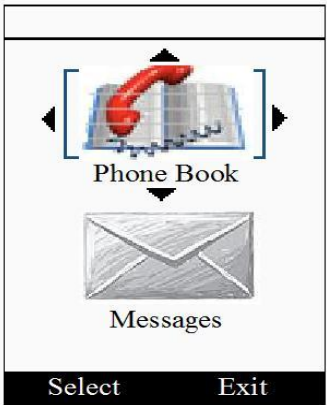


Figure 6.3.2:
Main Menu, Medium
mode, phonebook
selected

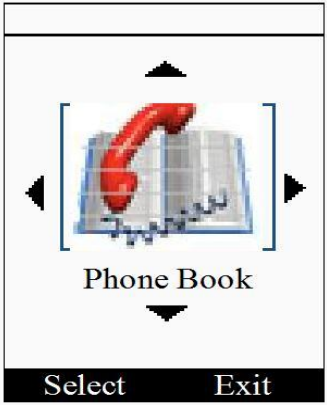


Figure 6.3.3:
Main Menu, Large
mode, phonebook
selected

Feedback: -Interface design must have the ability to feedback the user on their every query or action as shown in fig 6.4.



Figure 6.4:
Saved Feedback in all
Mode of Contact List

Structure: - The structure of the interface design is meaningful. All parts of the interface design are well structured, labels are used for information displaying and buttons are used for performing actions as shown in Appendix.

Consistency: - All the elements of the interface design are easy to remember and learn by their positioning and appearance. Position and function of standard elements must remain same throughout interface design as shown in flow diagrams in Appendix.

Tolerance: - Interface design must provide tolerance: prevents user making error or provides graceful fail as shown figure 6.5.

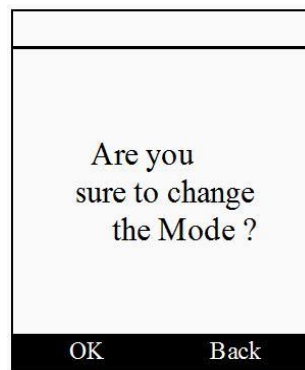


Figure 6.5
Mode Confirmation

Affordance: -Arrangement of all the elements of the interface design must be clear to the user to understand it. All the elements icons, labels and buttons are very clear to users even he has no experience of using mobile phones.

Navigations: - Navigation means move freely and it also inform the current location of the user as show in Appendix.

CHAPTER 7 DESIGN VALIDATION

We used the usability inspection approach to identify the usability related aspects of interfaces design.

7.1 Usability Inspection Approach

In usability inspection approach usability experts judge the usability related aspects of users interface [66]. Usability Inspection is a set of methods including heuristic evaluation, action analysis and cognitive walk-through. Inspection Methods are used to identifying the problems and improving the usability of the user interface by examining it against the recognized standards [67]. We decided upon heuristic evaluation method because it had proved to be cost effective, low time consumption and ease of application [70]

7.2. Heuristic Evaluation

In 1990, J. Nielsen and R. Molich developed heuristic evaluation method using a set of simple and general heuristic. Heuristic evaluation technique is the most common informal and most widely used inspection method. It involves usability expert who examine the interface design for compliance with established usability design principles [68]. Heuristic evaluation is best for design time evaluation because it is easier to fix the usability problems during the initial design phase [66].

7.2.1. Procedure of Heuristic Evaluation

Usually three to five expert (human factors engineer) evaluators are necessary for heuristic review, five experts recommended for life critical systems and no less than three for any heuristic review [67, 68]. In heuristic evaluation approach each individual evaluator examines the interface independently. Only completing the evaluation of interface design independently then evaluators are allowed to communicate and compile their results. This restriction is very important for unbiased and independent evaluation [67].

7.2.2. Pros and Cons

Advantages of heuristic reviews are cost less and it requires less time to conduct the evaluations [68]. Heuristic evaluation contains the known and established principles, successful discovery of major and minor problems, rapidity and usability throughout the development life cycle [67].

Disadvantages of heuristic evaluation are without end users, difficult to identify domain specific problems [67]. It is difficult to summarize the results because different evaluators report problems at different levels. The issue of severity is also serious problem because all usability problems are not equal priority [68].

7.2.3. Why we select Heuristic evaluation

In heuristic evaluation experts evaluators examine the interface and discover elements that violate the usability heuristics. Heuristic evaluation become very popular due to low cost and less time consuming and ease of application [69]. Evaluators can carry out the examination of interface in a few hours with minimal training. This method has been usually used to examine web sites and desktop software applications. It is typically used to identify the software interface usability problems to be managed in the design process. Heuristic evaluation can be applied to low fidelity paper & electronic mock-ups and prototypes [70].

Authors modify the heuristic evaluation method to concentrate on different issues in the evaluation of mobile phone interface design for elderly people. Firstly authors create a checklist of heuristics which support the evaluators to identify the usability problems while evaluating the interface design. Secondly evaluators use it to identify usability problems that mobile phone interface design for elderly people.

7.2.4. Heuristic Evaluation Planning

The purpose of heuristic evaluation is to identify the violation of usability heuristics during interface design. Heuristic evaluation was used to collect the quantitative data to identify the usability problems associated with interface design of the mobile phone. When evaluators completed the evaluation then statistic analysis was done to compile the final results.

The usability much lies on user interface performance. There are five experts student from the Department of Interaction and System design at BTH participated in user interface design evaluation. According to Nilesen, 75 percent of the usability problems would usually discovered by five participants [72].

7.3. Heuristics Evaluation of Mobile GUI

To give support to the evaluators in identifying usability problems, a list of heuristics is provided to them which can be used to generate ideas while evaluating the system. Heuristic check list was designed with all possible heuristics that support evaluators in identifying the usability violation in the software interface design of the mobile phone. The selection of heuristics and criteria is adopted [71].

We select Yung Gu Ji [71] usability check list for the usability evaluation of mobile phone user interface that specifically designed to measures the usability violation severity of mobile phone interface.

7.4. Evaluation Procedure

The evaluation procedure consists of three steps i.e. figure 3 illustrate the evaluation procedure. In initial step we gave training to selected participant on how to navigate the mobile phone user interface prototype, focus on the user interface element to be evaluated such as icons, main menus, sub menus, title, fonts etc and end user information. While In second step each participant alone navigates and evaluated the interface and filling the check

list. At the end checklists were collected. In the last session to gave verbal comments on the interface which were documented.

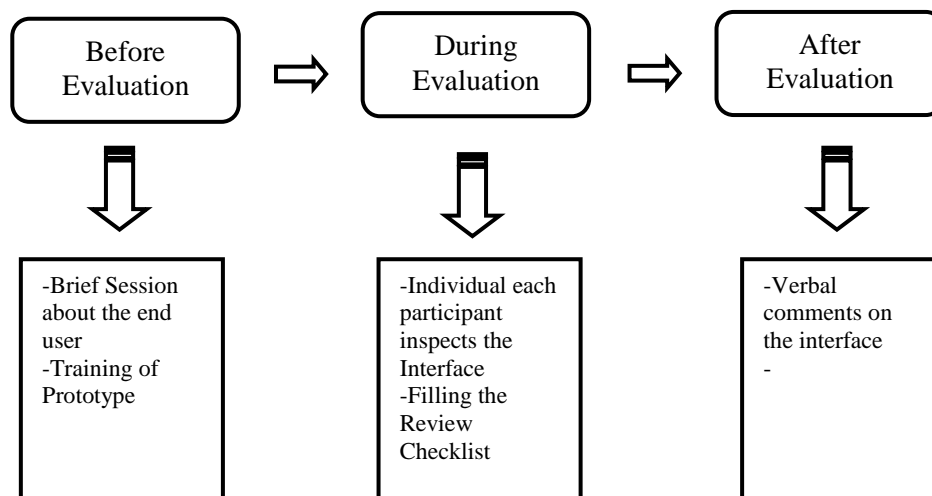


Figure 7.1 Evaluation Procedure

7.5. Checklist Findings

Mostly human factor engineer's feedback regarding the mobile phone user interface was positive.

7.5.1. Visibility of system status

The visibility of system status respondents was presented in table 7.1. Mostly respondents agreed that the interface match the visibility properties. Menu types are easy and clearly recognized on the screen. The weakness point into interface is the lack of a proper color highlighting should be different as reported by three respondents. Similarly another, the phonebook and related sub icons have different.

Table 7.1 visibility of system status

Review Checklist		Yes	No	N/A
1.1	Is the information indicated on idle screen clearly visible?	4	1	0
1.2	Is the menu type easy to identify?	5	0	0
1.3	Is the main menu visually clear and simple?	5	0	0
1.4	Is the main menu composed of related submenu?	4	1	0
1.5	Does every display begin with a title or header that describes screen contents?	4	1	0
1.6	Is there a consistent icon design scheme?	3	2	0
1.7	Is a single, selected icon clearly visible when surrounded by unselected icons?	5	0	0
1.8	Is the current status of an icon clearly indicated?	5	0	0

7.5.2. Match between system and the real world

The GUI of mobile phone icons can be easily mapped by the user to real world images for examples icons used for message, alarm, and setting. The GUI of mobile phone evaluators suggest that has some minor problems in terms of familiarity and natural language. Table 7.2 presents the respondents reports of match between system and the real world.

Table 7.2 Match between system and the real world

Review Checklist		Yes	No	N/A
2.1	Does the menu labelling follow the screen guideline?	5	0	0
2.2	Is menu labelling familiar and easy remember?	5	0	0
2.3	Are icons concrete and familiar?	3	2	0
2.4	The GUI interfaces clear, simple language?	4	1	0
2.5	Do menu choices fit logically into categories that have readily understood meanings?	5	0	0

7.5.3. User control and freedom

Fifty percent respondents are agreed that user has ease of navigation which enables them to seamlessly move from one display to another. For examples the GUI has placed 'BACK' to previous menus after he has reached to second depth menu screen. The weakness point is title and sub title must have distinguished to the user.

Table 7.3 User control and freedom

Review Checklist		Yes	No	N/A
3.1	Can users cancel out of operations in progress?	2	2	1
3.2	Is the list area distinguished clearly from the title area?	2	3	0
3.3	Is the configuration of second depth menu screen simple and clear?	5	0	0
3.4	Is the list area distinguished clearly from the title area?	3	1	0
3.5	Is the subtitle indicated clearly?	3	2	0

7.5.4. Consistency and standards

The respondents are mostly agreeing that the icons are consistent throughout the GUI of mobile phone.

Table 7.4 Consistency and standards

Review Checklist		Yes	No	N/A
4.1	Is the arrangement of icons consistent on the screen?	4	1	0
4.2	Does the selected icon distinguish clearly from other icons on the screen?	5	0	0
4.3	Are icons labeled?	5	0	0
4.4	Does the menu structure match the task structure?	5	0	0

7.5.5. Help users recognize, diagnose, and recover from errors

It presents the help users recognize but such as no particular messages through which the user can informed about the last recent action he / she performed.

Table 7.5 Help users recognize, diagnose, and recover from errors

Review Checklist		Yes	No	N/A
5.1	Are error messages grammatically correct?	2	1	2
5.2	When input is wrong is the information about the error indicated clearly?	1	1	3

7.5.6. Error prevention

There is no such feature included to indicate the number of character spaces available in a field.

Table 7.6 Error prevention

Review Checklist		Yes	No	N/A
6.1	Do data entry screens indicate the number of character spaces available in a field?	0	5	0

7.5.7. Recognition rather than recall

Mostly evaluators reported that the colors scheme on the menu good to recognize but it required more efficiently colors pattern of the GUI, thus enabling ease of navigation.

Table 7.7 Recognition rather than recall

Review Checklist		Yes	No	N/A
7.1	Are borders used to identify meaningful groups?	2	2	1
7.2	Has the same colour been used to group related elements?	3	1	1
7.3	Is colour coding consistent throughout the GUI?	4	1	0
7.4	Is there good colour and brightness contrast between image and background colours?	2	1	2
7.5	Have light, bright, saturated colours been used to emphasize data and have darker, duller, and desaturated colors been used to de-emphasize data?	1	3	1
7.6	Are there menu selection defaults?	4	1	0

7.5.8. Flexibility and efficiency of use

The study shows that mobile GUI is required more flexibility and efficiency to use for performing basic function like save, deletion, and edit.

Table 7.8 Flexibility and efficiency of use

Review Checklist		Yes	No	N/A
8.1	Is the visual expression of save process proper?	2	2	1
8.2	Is there an appropriate visual indicator for save delay?	1	2	2
8.3	Is sign on modification clear and proper?	2	0	3
8.4	Is modification success and failure properly notified	2	0	3
8.5	Is sign on deletion clear and proper?	4	1	0
8.6	Is deletion success and failure properly notified?	3	2	0

7.5.9. Aesthetic and Minimalist design

The expert participants mostly agree that the interface is simplistic and not too many variations in color. Familiar labels and icons used for various options for example search, add, delete, edit contact and messages inbox, etc are self explanatory and intuitive.

Table 7.9 Aesthetic and Minimalist design

Review Checklist		Yes	No	N/A
9.1	Are all icons in a set visually and conceptually distinct?	4	1	0
9.2	Does each icon stand out from its background?	5	0	0
9.3	Are meaningful groups of items separated by white space?	5	0	0
9.4	Does each data entry screen have a short, simple, clear, distinctive title?	3	2	0
9.5	Are field labels brief, familiar, and descriptive?	5	0	0
9.6	Are menu titles brief, yet long enough to communicate?	4	1	0
9.7	Is the search screen simple and clear so that users can search the item easily?	3	2	0

7.5.10. Help and documentation

Mainly all kinds of information and options available to the user and simple and clearly presented and displayed the relevant description. It's required more detailed information about the common procedural.

Table 7.10 Help and documentation

Review Checklist		Yes	No	N/A
10.1	Navigation: Is information easy to find?	5	0	0
10.2	Presentation: Is the visual layout well designed?	2	3	0
10.3	Conversation: Is the information accurate, complete, and understandable?	5	0	0
10.4	Is the information relevant?	5	0	0
10.5	Goal-oriented: What can I do with this program?	5	0	0
10.6	Descriptive: What is this thing for?	4	1	0
10.7	Procedural: How do I do this task?	3	2	0
10.8	Interpretive: Why did that happen?	5	0	0
10.9	Navigational: Where am I?	3	2	0

CHAPTER 8 DISCUSSION AND VALIDATION ASSESSMENT

Discussion and validation assessment of thesis is depicted in this chapter. In this chapter authors discuss challenges & barriers and strategies regarding the software interface of mobile phone for elderly people. This study was conducted to understand user experiences of elderly people with their mobile phones to identify implication for software interface, interaction design and opportunities for new interaction design.

8.1 Discussion

In gathering the elderly people requirements and after analyzing the results taken from the investigation the various challenges and issues came to light. To sum up, this research study showed the careful usability evaluation of mobile phone software interface to find the usability problems in the system and elderly people requirements against these problems. The authors used the questionnaires technique for usability evaluation. The authors derived results and statistics through usability questionnaires. In this chapter authors will discuss the results; finding from evaluation methods and designing software interface for elderly people needs & requirements.

8.1.1 Display

According to the statistical analysis of questionnaires it is suggested that there is a need to improve the display of mobile phone software interface by adding more visible fonts, icons and labels. In questionnaire analysis authors analyzed that to some extent elderly are satisfied with the mobile phone software interface and considerable ratio of elderly has a neutral response in favor of satisfaction level with mobile phone software interface.

8.1.2 Ease of use

Ease of use means, the extent to which using the system will free of effort. Authors analyzed that more than half of the elderly have a neutral response against simple and easy to use mobile phone software interface attribute. It indicates majority of the elderly thinks that their current mobile software interfaces are not up to the satisfaction level of simplicity and ease of use. On the other hand elderly ration with a little closer to majority level are agreed with the simplicity and ease of use attribute of mobile software interfaces.

8.1.3 Learnability

Learnability mean when user interacts with the interface design first time how easy is it for users to accomplish the task. Statistical analysis shows that majority of the people are satisfied with current interface of the mobile people. In addition to this considerable ratio of elderly have a neutral response against the same attribute. Authors found that the elderly who

are not satisfied with the learnability attribute of mobile phone software interfaces have a half ratio as compared to the elderly who are satisfied.

8.1.4 Usefulness and Problem Solving

Usefulness and problem solving means that the extent to which using a mobile phone is beneficial to their lives. Authors identified that half of the elderly thinks that their mobile phone software interfaces are useful and it also enables them to solve problems by themselves instead of taking help from others. In addition during analyzing questionnaires authors came to know that a close ratio to the half of the elderly are not satisfied with the usefulness and problem solving attribute of mobile phone software interfaces.

8.1.5 Minimum Memory Load

Minimize memory load because users could not memorize the bulk of information to carry out tasks. Memory load minimize user's ability to carry out the main tasks. For example Use

- 1- Menu design vs. commands
- 2- Hierarchical structure for interface design
- 3- Default values settings

Authors analyzed that elderly are working satisfactory according to their needs and they do not have to put efforts on memorizing things when they are dealing with current mobile phone software interfaces. In addition to this a little closes to the half ratio of elderly have a neutral response against minimum memory load attribute of mobile phone software interfaces.

8.2 Validation of GUI

After analysis of the validation of GUI mobile interfaces that more than 60 percent of responses were positive. These are some areas of heuristic problems which violated the interface design.

8.2.1. Main Title and Sub Title Difference

Due to same highlighting color usage, the users are unable to clearly differentiate between main title and subtitle. The different highlighting color of titles presents to clear and easily recognized by end users.

8.2.2. Ensure the consistence icons

Overall, validation study shows the icons are mostly consistent and match to the real world. But the main menu phonebook icon and sub icons are not same. Icon should be visually and conceptually is different because consistent icons on each display it is important feature of interaction design principle [65].

8.2.3. Provide GUI Ideal screen clear

The first or ideal screen of mobile phone indicates that there is no difference between the two buttons. The user might be confused so a small space provided between the buttons to separate from each other.

8.3 Validations

There are four criteria for judging the validity of the qualitative research: credibility, transferability, dependability and conformability proposed by Guba and Lincoln [14]. For validating the result authors first conducted the questionnaire from elderly diabetes type 2, after the questionnaire conduction, authors develop a paper prototype and carried out the evaluation of the paper prototype by expert users.

8.3.1 Credibility

According to Lincoln & Guba, that the results based on qualitative research are must be realistic and believable from the participants' point of view that is taking part in the research [14].

Author conducted a Usability evaluation of low fidelity prototype of mobile phone software interface carried out by expert software designer. These usability testing has helped the authors in validating the credibility of this study in chapter 7.

8.3.2 Transferability

According to Lincoln & Guba, it can be accomplished by describing and identifying the context of the research being performed and the assumptions that were consider for the study. It refer that results obtained from that research are applicable in other contexts.

The assumptions for this research were; the participants were males and females, age group between 59-70, Citizenship of Blekinge County, usage of mobile phone from 5 years, the environment use was public library, hospital cafeteria, and silent rooms. The authors suppose that by considering all these assumptions, transferability of this research is possible.

8.3.3 Dependability

According to Lincoln & Guba, it means occurring of changing in the context of research over time affects the results. It is the duty of the researcher to identify the context and their effects on research [14].

The authors achieved dependability in this thesis work by selecting citizen from the same county and filling the questionnaires from elderly people. Usability test of low fidelity prototype can perform from the same university. However in the case of usability

evaluation methods used, they affected the research work that it more valuable and informative from end user as compared to the university student.

8.3.4 Conformability

According to Lincoln & Guba, Conformability means the degree in which results could be confirmed by other researchers [14]. It refers that the outcomes from the research are the result of the participant's bias, inspiration or motivation rather than that of researchers.

In the case of this research work, documentation is done appropriately for each of the prototype designing and usability tests. For the sake of successful conveyance of these designing of low fidelity prototypes and usability tests at the earliest phase of this thesis literature review was done. Prototypes Design and Usability tests guidelines from other researchers were followed and in the last the procedure and results of this research was reviewed and examined by our advisors.

CHAPTER 9 EPILOGUE

This chapter contains conclusion, recommendation and future work of the mobile phone software interface for elderly people.

9.1 Conclusion:

The main aim of this research work is to identify the elderly people needs and requirements regarding the mobile phone software interface as well as the usability issues and satisfaction level. To support main aim extensive literature review is done to know what the problems of elderly with mobile phone software interface and what services existing software interface design are providing.

Author achieved that there are number of issues elderly people related with the design of the mobile phone software interface. The main challenges that some or all of the elderly with the mobile phone software are: Organization of the information on the screen, data display & color coding, hieratical menus& screen navigation, and icons, labels& symbols design.

After the Questionnaires analysis we found the Display, Ease of use, Ease of Learning, Usefulness and problem solving and Minimum Memory Load Criteria of Mobile phone Software interface in chapter 5 while the new GUI of Mobile phone Software Interface are presented in Chapter 6 and usability problems that affect the user interface issues are discussed in Chapter 7 of this thesis.

The author analyze that the use of a mobile phone software user interface by elderly people are considered to be not satisfied. Our approach to designing of GUI Mobile phone software Interface for elderly user was presented in Appendix. The main aim of this thesis to presents an easily interaction and navigation style that is supposed to be performed and clearly understand the mobile phone software interface of elderly people.

9.2 Recommendation

The authors have following recommendations that might be helpful in designing the software user interface of mobile phone for elderly people with declining eyesight. These recommendations are based on the literature review, findings of questionnaire results, and comments of elder people during questionnaires conductions, low fidelity prototype designing and testing.

- Avoid using different type of fonts. Select fonts based on their legibility.
- Use large font size
- Do not use abbreviations .All labels should be simple and short sentences.
- Avoid exceptionally bright, fluorescent or vibrant colors.
- Provide clear and consistent navigation mechanisms, avoid a very deep navigation.
- Minimize irrelevant information on screen.
- Clear organization of information content on a screen.

- Use simple, highly relevant icons and symbols with few colors and details.
- Provide the user with choice to switch between different modes(personalized setting)

9.3 Future Work

The authors believe that the recommendations given in this study might be helpful in designing and developing the software user interface of mobile phone for elderly people with declining eyesight. Some suggestions for future research are explained below, based on the findings from previous sections of thesis.

The future work is needed to develop the high fidelity prototype using the iterative approach, fix those outcomes which discussed in chapter 8 for testing. Furthermore after development of prototype it is required to deploy interface on the mobile phone and test from the actual user because user center design acquire the actual user requirements related to the interface. Authors recommended the Thinking-Out-Loud protocol to test the high fidelity prototype from the end user because for diagnostic or exploratory purposes, it provides the additional information about the user perceptions of the product's usability [35].

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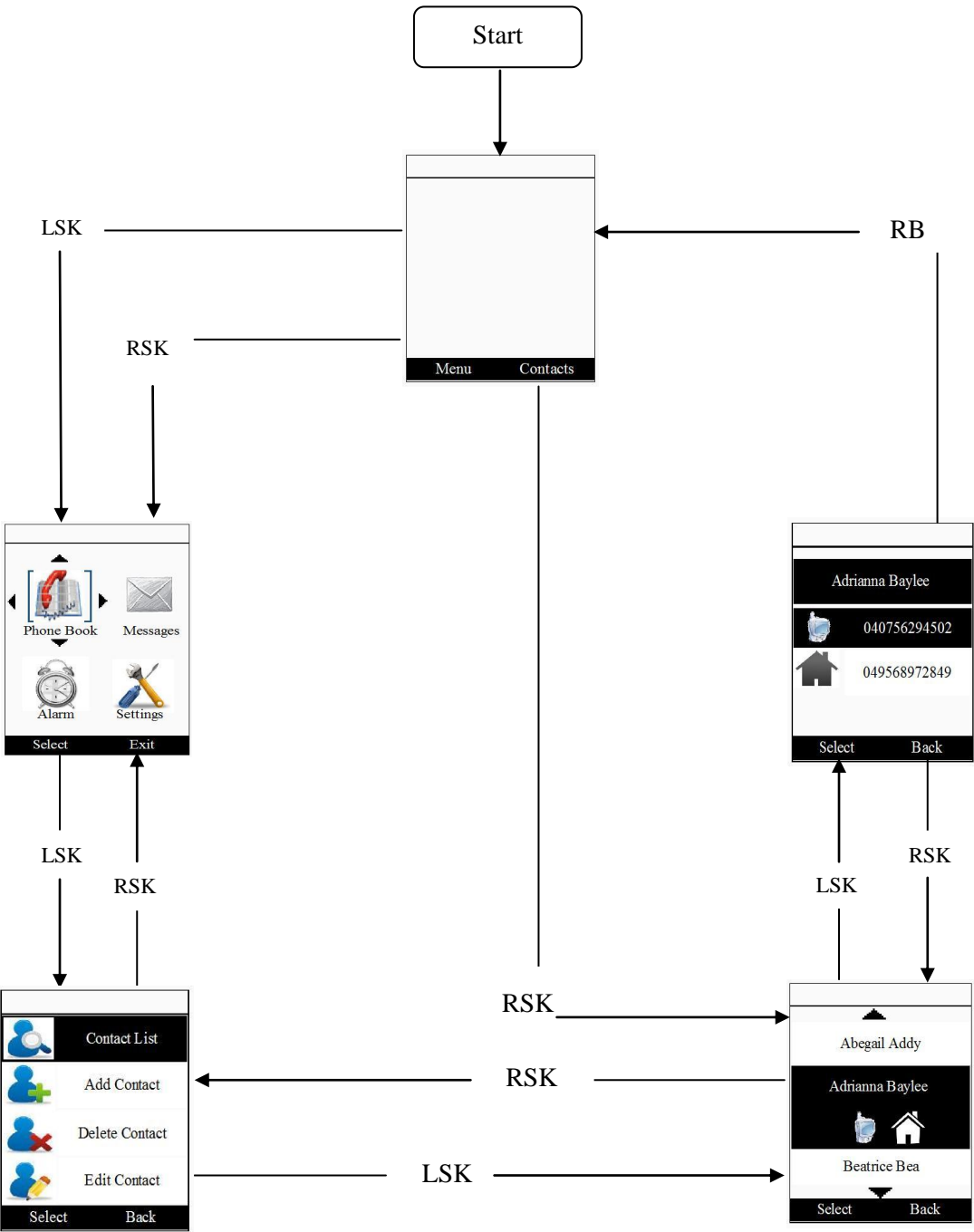
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APPENDIX 1

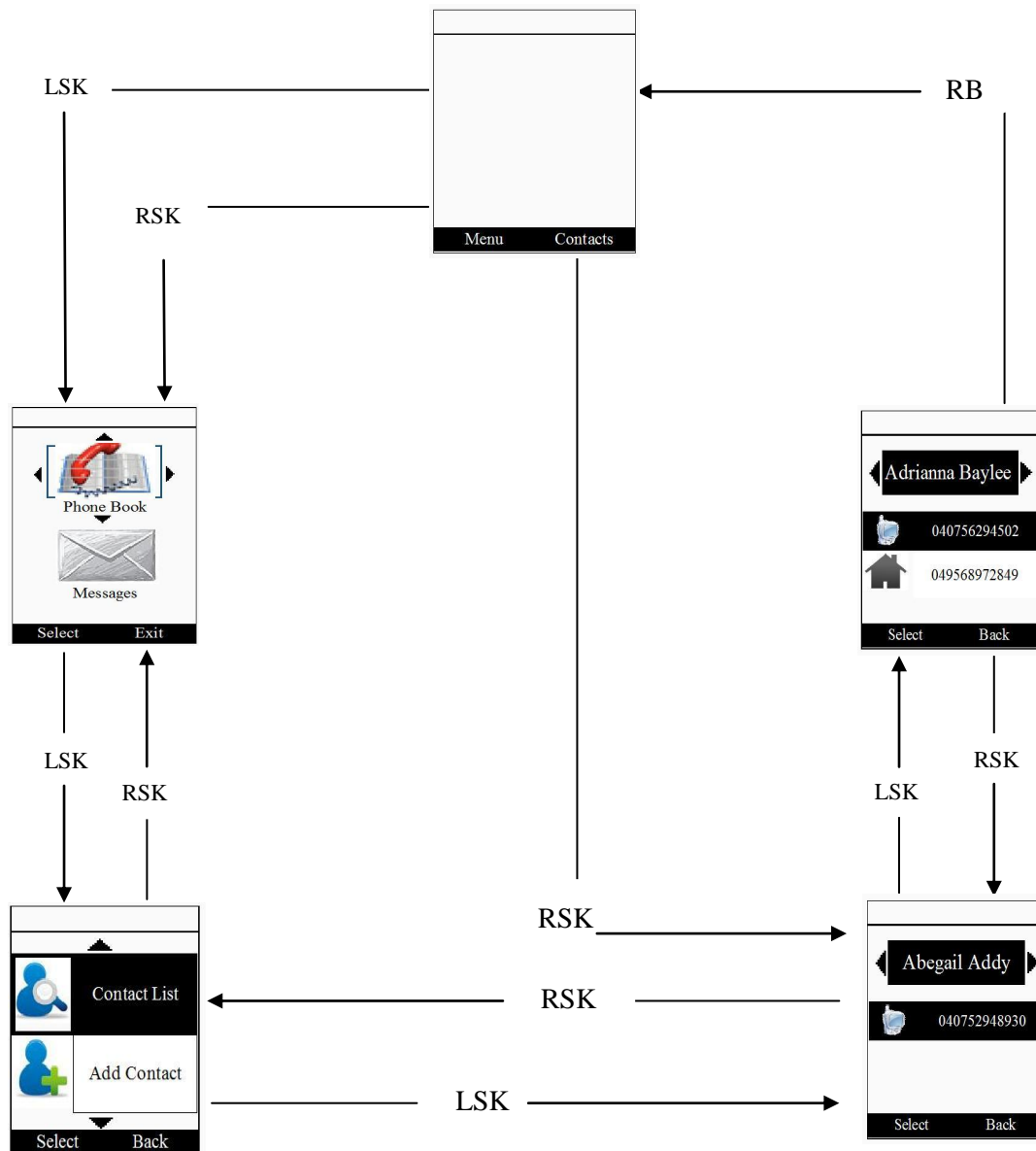
Flowchart 1

Normal Mode view: - This flowchart illustrates how to contact a person or search contact number in the Normal mode.



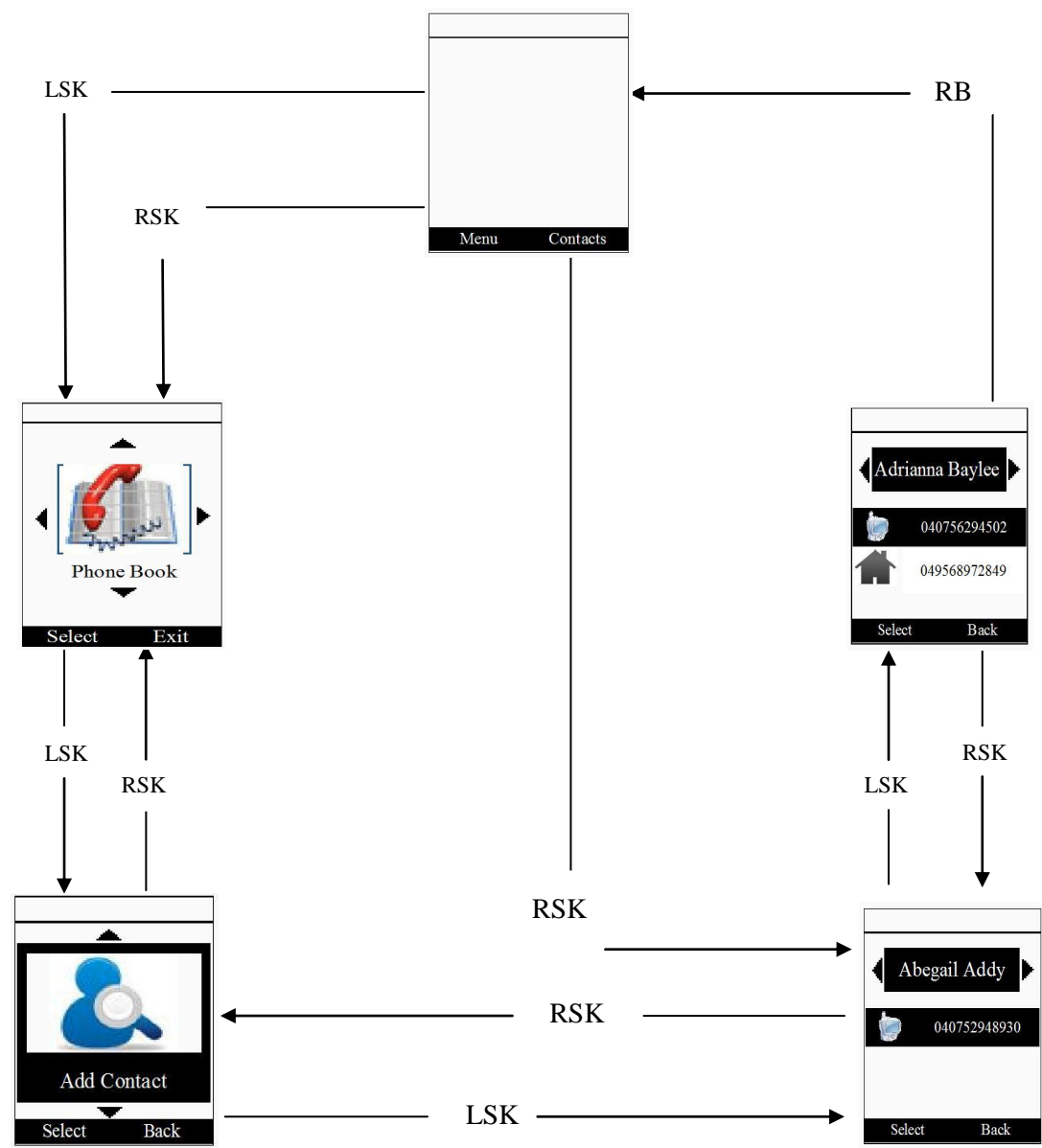
Flowchart 2

Medium Mode view: - This flowchart illustrates how to contact a person or search contact number in the Medium mode.



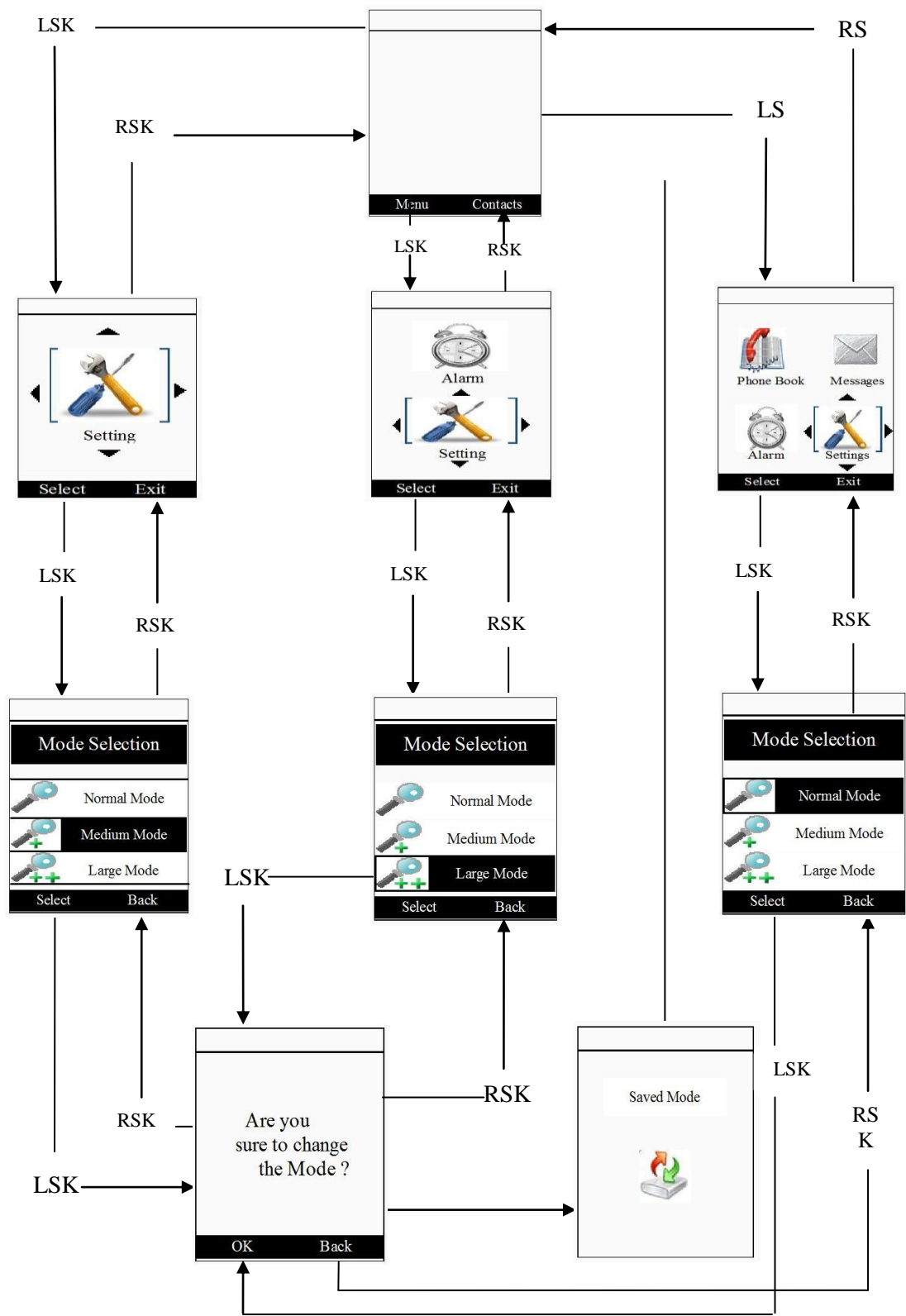
Flowchart 3

Large Mode View: - This flowchart illustrates how to contact a person or search contact number in the Large mode.



Flowchart 4

Selection Mode view: - This flowchart illustrates how to contact a change or selection of different mode.



APPENDIX 2

Prototype Results

The low fidelity prototype consists of an initial screen, main menu, phone book and setting, where the user enlarged the mode like normal, medium, and large in menus and lists can be set in the GUI.

Home

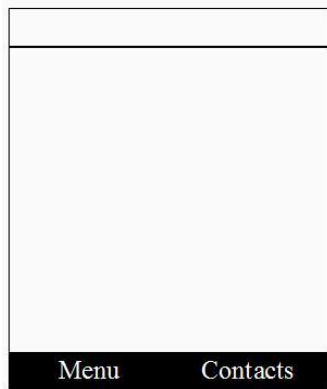
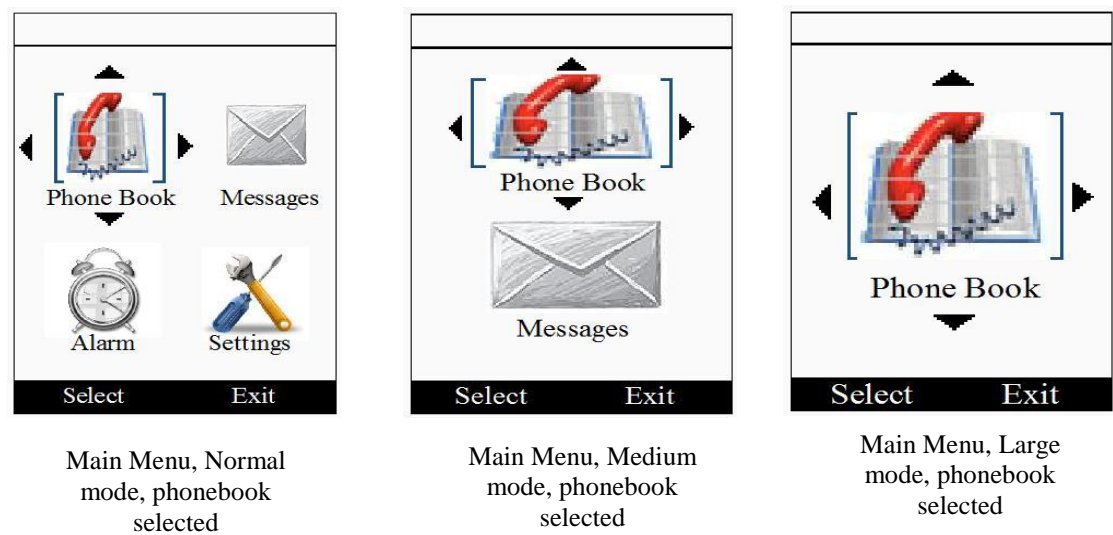


Figure 6.3: Home

Main Menu in Normal, Medium and Large



Contact List in Normal Mode



Normal mode,
phonebook selected



Medium mode,
phonebook selected



Large mode, phonebook
selected

Contact View in Normal Mode




Main Menu, normal
mode, phonebook
selected



Main Menu, Large
mode, phonebook
selected

Contact View in Medium and Large Mode


Abegail Addy


040752948930

SelectBack

Main Menu, normal mode, phonebook selected

Adrianna Baylee

040756294502

049568972849

SelectBack


Main Menu, Large mode, phonebook selected


Add a Contact in Normal Mode

Name

Adrianna Baylee

Phone Number

04075629450



SaveBack

Normal mode, Add Contact

Add a Contact in Medium and Large Mode

Name

Adrianna Baylee

OKBack

Add Name in Contact List

Phone Number

04075629450|



OKBack

Add Number (Both Number could be added i.e. Mobile and Home)

Saved Contact Feedback in All Mode



Saved Feedback in all Mode of Contact List

Delete and Delete Feedback of Contact in All Mode



Delete a Contact from the Contact List



Feedback a Delete a Contact from List

Message Menu in Normal, Medium and Large



Messages, Normal Mode

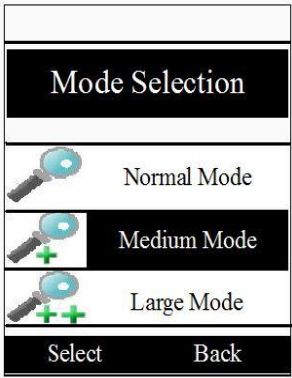


Messages, Medium Mode

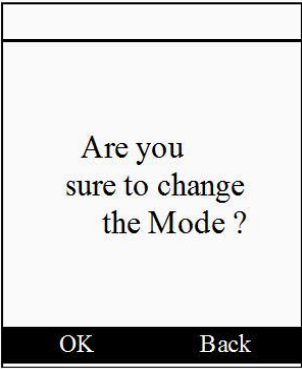


Messages, Large Mode

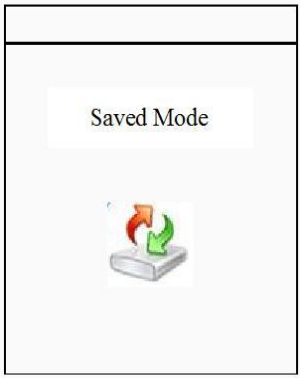
Mode Selection and Feedback



Selection, Mode Selection



Mode Confirmation



Selection, Feedback of Mode Confirmation

APPENDIX 3

SECTION A. General Questions about Mobile Phone Use

1) Do you have a cell phone? ☐ Yes ☐ No

2) How many years have you have a cell phone? _____ Years.

Please indicate the level which you agree with the statement.

S.No	Questionnaires	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The reason I have a cell phone is.						
1	Personal Communication with family and friends					
2	To save information e.g. phone numbers & personal notes					
3	Safety and security					
4	Entertainment e.g. game and music					

SECTION B. Questions about Your Current Cell Phone

1) What model of cell phone do you have currently?

a. Manufacturer: _____ (e.g. Motorola, Nokia, Sony Ericson, etc.)

b. Model name (check the inner side of battery case): _____ (e.g., Nokia E71, etc.)

Please indicate the level which you agree with the statement.

S.No	Questionnaires	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Display and Ease of Use...						
1	It is relatively easy to move from one part of a task to another.					
2	All the operations can be carried out in a similar way					
3	The operations of this product are simple and uncomplicated.					
4	The organization of information on the product screen is clear.					
5	The colour coding and data display are compatible with familiar conventions.					
6	It is easy to access the information that you need from the product.					
7	It is easy for you to remember how to perform tasks with this product.					
8	The interface of this product is clear and understandable.					
9	The characters on the screen are easy to read.					

10	Interacting with this product require a lot of mental effort.					
11	It is easy to navigate between hierarchical menus and screen.					
12	Backlighting feature for the keyboard and screen is helpful.					

Please indicate the level which you agree with the statement.

S.No	Questionnaires	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Feedback on the completion of tasks is clear.					
2	Pictures on the screen are of satisfactory quality and size.					
3	The design of the graphic symbols, icons and labels on the icons sufficiently relevant					
4	The amount of information displayed on the screen is adequate					

SECTION C. Use of Technology

1) How frequently do you use the following technology?

Technology	More than once per day	Once a day	Once per week	More than once Per week	Never
Computer					
Internet					
Email					

SECTION E. Demographic Information

We need some demographic information about you to make a significant analysis of the results. This information will only be used to provide an overall sketch of all respondents. It is not analyzed individually for each individual. Please check or write in your answers to these questions.

1) Age: (_____) years old

2) Gender: ☐ Female ☐ Male

3) Are you use mobile phone for health application. ☐ Yes ☐ No